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Load Sensing System

The present invention relates to braking systems for vehicles, and is particularly concerned with braking systems for passenger or load-carrying vehicles, most particularly light commercial vehicles.

Commercial vehicles have for many years been fitted with servo braking systems which apply brake fluid, which may be a hydraulic fluid or air, to brake actuator cylinders in response to control inputs from the vehicle driver. Pressure of the driver's foot on a brake pedal controls the flow of brake fluid to operate the brake actuator cylinders and apply brake shoes or pads to the vehicle wheel hubs or brake discs, respectively. The fluid is provided to the actuator cylinder from a high-pressure source via a servo device. By this means, the force applied by the driver to the pedal is amplified to the levels necessary to arrest the movement of a heavy vehicle.

In commercial vehicles, it is desirable for the vehicle to be able to carry a large payload in proportion to the unladen weight of the vehicle, and thus there is great variation between the unladen and fully laden weights of such vehicles. When the vehicle is unladen, deceleration can be achieved satisfactorily with

relatively low fluid pressures in the brake actuator cylinders. As the total weight of the vehicle increases, braking requires higher fluid pressures in the brake actuator cylinders in order to produce the same deceleration rate. It is also necessary to provide a braking system which provides predictability to the driver, by giving the same or similar deceleration rates for similar pedal pressures at any loading state of the vehicle. This is achieved by providing a braking system which, for the same pedal pressure applied by the driver, applies less fluid pressure to the brake actuator cylinders when the vehicle is unladen than when it is heavily loaded.

To effect such a control of the vehicle braking system, it is conventional to provide a throttling valve, known as the "load sensing valve" in the fluid circuit supplying the brake actuator cylinders. The load sensing valve comprises a valve body and an operating arm, the valve body having a passage provided with a variable throttling element whose throttling effect is varied by moving the operating arm. The valve body is conventionally fixed relative to the vehicle body and the operating arm is attached to an axle of the vehicle on spring-suspended vehicles. This arrangement may however be reversed. As more load is placed on the vehicle, the

suspension springs are compressed, and the distance between the points to which the load sensing valve is attached varies as the axle moves nearer to the vehicle body. The compression of the suspension springs progressively reduces the "ride height" of the vehicle as it is more heavily loaded, and acts as an indicator of the weight of the vehicle. An individual correlation will therefore exist between the loading state and the ride height of the vehicle, depending on the characteristics of the suspension springs. The driver of the vehicle will become accustomed to the braking performance of the vehicle at various loading states.

The operation of the load sensing valve is to provide a strong throttling action to reduce the flow of brake fluid to the brake actuator cylinders when the vehicle is lightly loaded, and when the vehicle is heavily loaded to provide little or no throttling action and allow brake fluid to flow unimpeded to the brake actuator cylinders when the driver applies pedal pressure. The actual braking effect generated by the brake actuator cylinders thus increases as the vehicle is more heavily loaded. Each vehicle has a design relationship between the gross weight and the braking amplification factor, calling for a predetermined

load sensing valve over the range of vehicle weight from unladen to maximum gross weight. Typically, the load sensing valve will reduce the brake fluid pressure by some 1500psi when the vehicle is unladen, and will allow free flow when the vehicle is at its maximum gross weight.

In recent years the use of "air suspension" has become widespread in heavy goods vehicles. However, in applying this technology to light goods and passenger vehicles, vans or the like a significant difficulty has emerged as regards the variation of braking performance with vehicle weight.

In vehicles using air suspension, the vehicle is supported on its axles not by springs but by suspension units or "bags" filled with air under pressure. The "bags" may be flexible structures of toroidal or other form, or may be telescoping structures having sliding or rolling diaphragm seals. The "ride height" of the vehicle is controlled by varying the pressure within the bags, and thus is no longer dictated by the gross vehicle weight. The bags may also be inflated or deflated to raise or lower the vehicle body in relation to the ground, this feature being of great assistance in loading the vehicle, since by lowering the vehicle body the height to which cargo need be lifted to enter the

vehicle's loadspace is reduced.

It has been found that the handling and "driveability" of the vehicle is improved by adopting a control system for the bag pressure which adjusts the ride height to a maintain it at a constant level slightly below the unladen position. Such a control provides for a predetermined amount of suspension travel at all loading states, to maintain the ground clearance of the vehicle at a required distance. Ride height control may be achieved by admitting air into or venting air from the bags in response to a measurement of ride height. Maintaining a constant ride height however means that the ride height cannot be used as an indicator of the vehicle's gross weight in a control arrangement for the braking system.

An objective of the present invention is to provide a braking system for a vehicle with air suspension, wherein the brake servo amplification factor increases in proportion to an increase of the gross vehicle weight.

Another objective of the invention is to provide a braking system for a vehicle with air suspension, wherein the braking performance varies as a function of the gross vehicle weight throughout a predetermined weight range.

A further objective is to provide a load sensing arrangement for a vehicle with air suspension, operable

to control the braking system of the vehicle in accordance with the gross vehicle weight.

A yet further objective of the invention is to provide a combined air suspension and braking system for a vehicle, whereby a substantially constant ride height may be maintained and the braking effect varied in accordance with the gross vehicle weight.

In accordance with a first aspect of the invention, there is provided a vehicle having a body suspended on one or more axles by means of gas-filled bags, the vehicle being provided with means to vary the pressure within the bags to control the spacing between the body and the axle or axles and a braking system supplying a brake fluid to braking actuators operable to brake the vehicle's wheels, and further comprising a load sensing valve operable to apply a variable throttling effect to impede the flow of brake fluid to the braking actuators, characterised in that the throttling effect of the load sensing valve is varied by a control means responsive to the pressure within the gas-filled bags.

A second aspect of the present invention provides a load sensing arrangement for a braking system of a vehicle with air suspension, the load sensing arrangement comprising a sensor for detecting the air pressure in the air suspension, a variable throttling valve operable to

control the flow of brake fluid to a brake actuator, and control means to vary the throttling effect of the throttling valve in dependence on the output of the pressure sensor.

In an advantageous embodiment of the load sensing arrangement, the variable throttling valve comprises a valve element movable between closed and open positions to vary the throttling effect, and a fluid pressure actuator responsive to the pressure in the air suspension and operable to urge the valve element toward its open position against a restoring force. The restoring force may be provided by a second fluid pressure actuator, or by a resilient element such as a spring. The second fluid pressure actuator may be supplied with fluid at a reference pressure. Alternatively, the second fluid pressure actuator may be supplied with fluid at one of a number of pressures selected on the basis of the vehicle load.

In an alternative embodiment of the load sensing arrangement, the pressure in the air suspension is sensed by an electrical or electromechanical sensor to provide an electrical output signal corresponding to the suspension pressure, and the variable throttling valve is electrically controllable to vary the flow of brake fluid to a brake actuator, and a control circuit varies the

throttling effect of the throttling valve in dependence on the output signal from the pressure sensor. It is further foreseen that the suspension and braking systems may be interlinked by an electrical or electronic control means, by providing sensors giving electrical output signals relating to ride height to control the supply of air to the suspension units, a detector to give an electrical output corresponding to suspension unit pressure, and an electrically controllable throttling valve to vary the flow of brake fluid to a brake actuator, the control means providing control signals to the throttling valve in dependence on the sensed suspension unit pressure.

Embodiments of the invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view of an air suspension system and associated braking system according to a first embodiment;

Figures 2A and 2B are a schematic views of the load sensing valve of the suspension and braking system of Figure 1 when the vehicle is lightly loaded and heavily loaded, respectively;

Figure 3 is a schematic diagram showing an

sensors;

Figure 4 is a schematic diagram of the control system of the embodiment shown in Figure 3; and

Figure 5 is a schematic diagram similar to Figure 1 illustrating a further alternative embodiment of the braking control system.

Referring to Figure 1, there is shown an air suspension system for a vehicle comprising an air compressor 1, an air reservoir 2, a ride height sensor 3 and a pair of air bags 4. The air bags 4 are positioned between the vehicle body (not shown) and the vehicle axle, to support the body.

The ride height sensor 3 is a valve which in one control position can admit air from the reservoir 2 to the air bags 4, and in a second control position seals the air bags from the reservoir, and in a third control position can allow air to escape from the air bags 4 to atmosphere. The ride height sensor 3 is conventionally

position and air is neither admitted to nor vented from the air bags 4. The datum position of the body is set to be slightly below the body height at maximum suspension extension, to provide for the maximum usable suspension travel during operation of the vehicle while enabling the suspension to lift the vehicle body slightly above datum height during a transition from a loaded to an unloaded state.

When an increase in load compresses the air bags 4, and lowers the vehicle body from its datum position, the ride height sensor is moved to its first control position and air is admitted to the air bags to reinflate them until the datum height is regained.

With a decrease in load, the air bags 4 expand and lift the vehicle body slightly above its datum position. The ride height sensor is then moved to its third control position and air is vented from the air bags to deflate them until the vehicle body returns to datum height.

The vehicle braking system comprises a brake pedal 10, linked to a master cylinder 11 to provide a brake pressure input to a servo 12. Servo 12 increases the brake pressure and supplies the increased pressure to load sensing valve 13. Valve 13 throttles the brake fluid, and controls its passage to brake actuator cylinder 14. When fluid is supplied to the actuator

cylinder 14, brake shoes 15 expand to contact brake drum 16 and slow the vehicle. While an expanding shoe drum brake has been shown schematically in the Figure, it will be understood that any brake mechanism operated by fluid pressure may be used. Likewise it is to be understood that the fluid pressure may be transmitted by hydraulic fluid or other liquid, or by a compressed gas such as air.

The load sensing valve is shown schematically in Figures 2A and 2B, and comprises a valve body 20 having an inlet 21 and an outlet 22 for brake fluid. An internal passage 23 in the body 20 connects the inlet 21 to the outlet 22, and includes a throttling element 24 controlled by a swinging arm 25. The position of the swinging arm 25 determines the amount of throttling or flow restriction in the passage 23 by advancing or retracting throttling element 24 into or from the passage 23.

Two actuators 26 and 27 exert forces on the swinging arm 25. Actuator 26 is a fluid actuator, in this case an air bag similar to the air bags 4 but on a reduced scale, and is in fluid communication via a duct 28 with the air bags 4 of the suspension system. Fluid pressure within the actuator 26 is the same as the fluid pressure in the air bags 4, and is thus dependent on the gross vehicle

weight. The force exerted by the actuator 26 on the swinging arm 25 is in the sense of retracting the throttling element 24 from the passage 23, i.e. decreasing the throttling effect of throttling element 24.

A second actuator 27 acts on the swinging arm 25, in the opposite sense to the actuator 26. Fluid pressure is supplied to the second actuator 27 from the reservoir 2, via a pressure regulator 29 (seen in Figure 1). The pressure within the actuator remains constant, but it is a feature of the air bag type of actuator that its "spring rate" increases as its volume decreases.

In operation, the load sensing valve is in the position shown in Figure 2A when the vehicle is lightly loaded. An increase in vehicle weight causes the vehicle body to drop, and the ride height sensor 3 operates to provide compressed air to the air bags 4 to lift the body back to its datum position. The pressure within the air bags 4 is thus increased, and this increased pressure is transmitted via duct 28 to the actuator 26, increasing its force. The increased force of actuator 26 overcomes the resistance of actuator 27, and swinging arm 25 moves to a new position (Figure 2B) in which the throttling element 24 is retracted from the passage 23 to reduce the throttling effect of the load sensing valve.

actuator 27, although supplied with fluid at a constant reference pressure, provides a progressively increasing resistance force as the actuator 27 is compressed.

Similarly, as the vehicle weight is reduced, the ride height sensor 3 causes a pressure drop in the suspension air bags 4, and thus also in actuator 26, allowing actuator 27 to move the swinging arm 25 clockwise as seen in Figures 2A and 2B to increase the throttling effect of the load sensing valve.

The second actuator is a fluid actuator in the embodiment shown, but in alternative embodiments may be a resilient element such as a tension or compression spring, or a torsion spring operating on the swinging arm pivot. The spring may have a constant or a variable rate, i.e. the spring force may vary linearly or non-linearly as the position of the swinging arm changes.

In the embodiment shown in Figure 3, the fluid communication via duct 28 between the braking and suspension systems is replaced by an electronic control system. In Figure 3, the suspension system again comprises a compressor 1, a reservoir 2 and air bags 4. A ride height sensor 30, which may be a variable resistor or capacitance or a position sensor cooperating with the suspension members, is arranged to produce an electrical output signal corresponding to the ride height.

An electromechanical valve 35 serves as the "load sensing valve", and is controllable by the control circuit 31 to exert a variable throttling effect on brake fluid passing from servo 36 to brake assembly 37.

The control circuit 31 is seen in detail in figure 4, and comprises a memory 40 for storing data, a processor 41, ROM memory 42 for storing operation programs, and RAM 43 providing working memory for the processor 41.

Sensor inputs from the ride height sensor 30 and the pressure transducer 34 are provided to control circuit 31, as are inputs from the input device 32. A display 43 may be provided to display parameters such as desired ride height. The control circuit provides control signals to a ride height valve 33, and to an electromechanical valve 35.

The output signal from ride height sensor 30 is fed to the control circuit 31, which compares the sensed ride height value with a desired ride height value stored in memory 40. The desired ride height value may be selected by the driver using an input device such as a keyboard 32. On the basis of the comparison, control circuit 31 provides a control signal to the ride height valve 33 either to admit air to the air bags 4, or vent air therefrom, to bring the sensed ride height to the desired

ride height.

A pressure transducer 34 then senses the pressure in the air bags 4, and provides an output signal to the control circuit 31 corresponding to the sensed pressure. This output is also indicative of the vehicle weight when the vehicle is at the desired ride height, since the ride height adjustment raises or lowers the pressure in accordance with the vehicle weight.

On the basis of the sensed pressure, control circuit 31 provides control signals to an electromechanical valve 35 in the braking circuit to vary its throttling effect. The valve 35 acts in the same way as the load sensing valve 13 of the embodiment shown in Figure 1. The control circuit may include a look-up table 40a in memory 40 correlating values of sensed air bag pressure at the desired ride height with required positions for the throttle valve.

In an alternative embodiment, a conventional load sensing valve may be used, with an electromechanical actuator, such as a linear motor or a stepper motor and gearing, controlled by the control circuit 31 to position the swinging arm of the load sensing valve at the appropriate position for the sensed vehicle weight. Such an arrangement is contemplated for retro-fitting air suspension to light commercial vehicles originally

equipped with spring suspension.

The memory 40 of control circuit 31 may be provided with a look-up table 40a correlating a range of values of ride height and suspension air bag pressure with gross vehicle weight, so that for any combination of sensed values of pressure and ride height, the gross vehicle weight can be immediately read out from the table. Valve 35 can then be controlled on the basis of this gross weight value, without having to wait for the ride height control to inflate or deflate the air suspension to reach the desired ride height value for sensing the air bag pressure and thereby obtaining the gross weight. The look-up table 40a may be generated in a calibration process wherein the ride height is varied at different gross weights, and correlating pairs of sensor outputs from the ride height and air pressure sensors are noted for each loading state.

The display 43 may be provided with data to display the instantaneous vehicle weight and actual ride height, and input device 32 may be used by the driver to raise or lower the ride height for loading and unloading, for example to match the vehicle height to a loading dock or kerb. For example, the control circuit 31 may include circuitry enabling the driver to increase or decrease the ride height incrementally, for example in 10mm steps, t

match a loading dock height and the vehicle load bed height.

Figure 5 shows an alternative embodiment of the suspension and braking control system. In this Figure components corresponding to components in Figure 1 have been assigned the same reference numerals. In Figure 5, the compressor 1 supplies air to the air reservoir 2, which supplies air via a water separator 52 and a non-return valve 53 to the ride height sensor 3. Air is supplied to the suspension air suspension airbags 4 via a line 54, in which a pressure switch 55 is installed to sense the air suspension pressure.

The pressure switch 55 is operatively connected to pressure regulator 29, which controls the air pressure in the second actuator 27. Pressure regulator 29 is capable of supplying air to the second actuator 27 at at least two controlled pressures, the reference pressure output by regulator 29 being selected in accordance with the air pressure sensed by the pressure switch 55.

In a first control arrangement, the pressure switch 55 is configured as a threshold detector, and gives a first output when the sensed pressure is below a predetermined threshold, and a second output when the sensed pressure is above that threshold. The pressure regulator 29 is arranged to provide first and second

reference pressures, and is operatively connected to the threshold detector 55 so that when the sensed pressure in the air suspension is below the threshold, the pressure regulator 29 provides a lower reference pressure to the second actuator 27. When the sensed pressure in the suspension is above the threshold, the pressure regulator 29 provides a higher reference pressure to the second actuator 27. In a typical arrangement in which the axle load of the vehicle varies from 700kg to 3200kg, the pressure in the suspension airbags may vary from 3.4 to 7.5 bar (50 to 110 psi) and the pressure supplied to the second actuator 27 may be 1.5 bar (22 psi) when the air suspension pressure is at or below 5.8 bar (85 psi), and 1.9 bar (28 psi) when the air suspension pressure is above 5.8 bar.

In a second, alternative control arrangement the pressure switch 55 may be configured with a number of thresholds, dividing the range of pressure variation in the suspension airbags into a plurality of sub-ranges. The pressure regulator 29 may then be configured to provide a plurality of different reference pressures, each corresponding to one of the sub-ranges. In the typical example referred to above, the pressure switch 55 and pressure regulator 29 may be configured to deliver a

first reference pressure of 1.5 bar (22 psi) when the suspension pressure is from 3.4 to 3.8 bar (50 to 55 psi), a second reference pressure of about 1.58 bar (23 psi) when the suspension pressure is from 3.8 to 4.1 bar (55 to 60 psi), a third reference pressure of about 1.65 bar (24 psi) when the suspension pressure is from 4.1 to 4.47 bar (60 to 65 psi), a fourth reference pressure of about 1.72 bar (25 psi) when the suspension pressure is from 4.47 to 4.8 bar (65 to 70 psi), a fifth reference pressure of about 1.79 bar (26 psi) when the suspension pressure if from 4.8 to 5.1 bar (70 to 75 psi), a sixth reference pressure of about 1.86 bar (27 psi) when the suspension pressure is from 5.1 to 5.5 bar (75 to 80 psi), and a seventh reference pressure of about 1.9 bar (28 psi) when the suspension pressure is above 5.5 bar (80 psi).

As an alternative to a single pressure regulator 29 which can supply a plurality of different reference pressures, each of the reference pressures may be provided by a separate pressure regulator 29, with the pressure sensor 55 controlling a selector valve arrangement to connect the appropriate pressure regulator 29 to the second actuator 27.

In a third alternative control arrangement, the pressure

regulator 29 may be adapted to provide a continuously variable reference pressure to the second actuator 27, and may be controlled by the pressure sensor 55 to increase the reference pressure in the second actuator from about 1.5 bar (22 psi) to about 1.9 bar (28 psi) as the sensed pressure in the suspension airbags increases of from about 3.4 top about 5.5 bar (50 to 80 psi).

CLAIMS

1. A vehicle having a body suspended on one or more axles by means of gas-filled suspension units, the vehicle being provided with means to vary the pressure within the suspension units to control the spacing between the body and the axle or axles and a braking system supplying a brake fluid to braking actuators operable to brake the vehicle's wheels, and further comprising a load sensing valve operable to apply a variable throttling effect to impede the flow of brake fluid to the braking actuators, characterised by further comprising means to vary the throttling effect of the load sensing valve in dependance on the pressure within the gas-filled suspension units.

2. A vehicle according to claim 1, comprising a sensor for detecting the air pressure in the air suspension units, and control means responsive to the sensor output for varying the throttling effect of the load sensing valve.

3. A vehicle according to claim 1 or claim 2, wherein the load sensing valve includes a movable throttling element having a first position wherein a max-

throttling effect is exerted, and a second position wherein a minimum throttling effect is exerted, and further comprises first actuating means to urge the throttling element toward its second position with a force dependant on the pressure in the gas-filled suspension units, and second actuating means to urge the throttling element toward its first position with a force dependant on the position of the throttling element and increasing as the throttling element approaches its second position.

4. A vehicle according to claim 3, wherein the first actuating means is a fluid actuator to which the pressure of the gas-filled suspension units is communicated.

5. A vehicle according to claim 3 or claim 4, wherein the first actuating means is an air bag.

6. A vehicle according to any of claims 3 to 5, wherein the second actuating means is a fluid actuator supplied

8. A vehicle according to claim 6 or claim 7, further comprising a pressure regulator means for supplying a reference fluid pressure to the second actuating means.

9. A vehicle according to claim 8, wherein the pressure regulator means is capable of supplying a number of reference fluid pressures, the vehicle further comprising pressure sensing means operable to sense the pressure in the suspension units and control means operable to select one of said reference fluid pressures on the basis of the sensed pressure and to supply said selected reference fluid pressure to the second actuating means.

10. A vehicle according to claim 9, wherein the pressure regulator means is capable of supplying first and second reference pressures, and the pressure sensing means provides a first output when the sensed pressure is below a predetermined threshold and a second output when the sensed pressure is above the predetermined threshold, and

11. A vehicle according to any of claims 3 to 5, wherein the second actuator is a resilient element.

12. A vehicle according to claim 11 wherein the resilient element is a spring.

13. A vehicle according to claim 1 or claim 2, wherein the load sensing valve includes a movable throttling element having a first position wherein a maximum throttling effect is exerted, and a second position wherein a minimum throttling effect is exerted, and further comprises a positioning actuator operable to position the throttling element at a point between its first and second positions.

14. A vehicle according to claim 13, further comprising means for sensing the pressure within the gas-filled

16. A vehicle according to claim 14 or claim 15, wherein the control means comprises means to determine a desired position for the throttling means on the basis of the sensed pressure, and means to operate the positioning actuator to bring the throttling means to the desired position.

17. A vehicle according to any of claims 14 to 16, wherein the output of the pressure sensing means is an electrical signal.

18. A load sensing system for a braking system of a vehicle having a vehicle body supported on an axle by a pressurised air suspension unit whose pressure is varied as the vehicle load varies, the load sensing system comprising a variable throttling valve operable to control the flow of brake fluid to a brake actuator, and control means to vary the throttling effect of the throttling valve in dependence on the pressure in the air suspension unit.

19. A load sensing system according to claim 18 comprising a sensor for detecting the air pressure in the air suspension units, and control means responsive to the

load sensing valve.

20. A load sensing system according to claim 18 or claim 19, wherein the variable throttling valve comprises a valve element movable between closed and open positions to vary the throttling effect, and a fluid pressure actuator responsive to the pressure in the suspension unit and operable to urge the valve element toward its open position against a restoring force.

21. A load sensing system according to claim 20, wherein the restoring force is provided by a second fluid pressure actuator.

22. A load sensing system according to claim 21, wherein the second fluid pressure actuator is supplied with fluid at a regulated pressure.

23. A load sensing system according to claim 21, wherein the second fluid pressure actuator is an air bag.

24. A load sensing system according to claim 22 or claim 23, further comprising a pressure regulator means for supplying a reference fluid pressure to the second actuating means.

25. A load sensing system according to claim 24, wherein the pressure regulator means is capable of supplying a number of reference fluid pressures, the vehicle further comprising a pressure sensing means operable to detect the pressure in the suspension units and control means operable to select one of said reference fluid pressure on the basis of the sensed pressure and to supply said selected reference fluid pressure to the second actuating means.

26. A load sensing system according to claim 25, wherein the pressure regulator means is capable of supplying first and second reference pressures, and the pressure sensing means provides a first output when the sensed pressure is below a predetermined threshold and a second output when the sensed pressure is above the predetermined threshold, and the control means is operable to provide the first reference pressure to the second actuating means when the pressure sensing means provides the first output, and to provide the second reference pressure to the second actuating means when the pressure sensing means provides the second output.

27. A load sensing system according to claim 20, wherein the restoring force is provided by a resilient element.

28. A load sensing system according to claim 27, wherein the restoring force is provided by a spring.

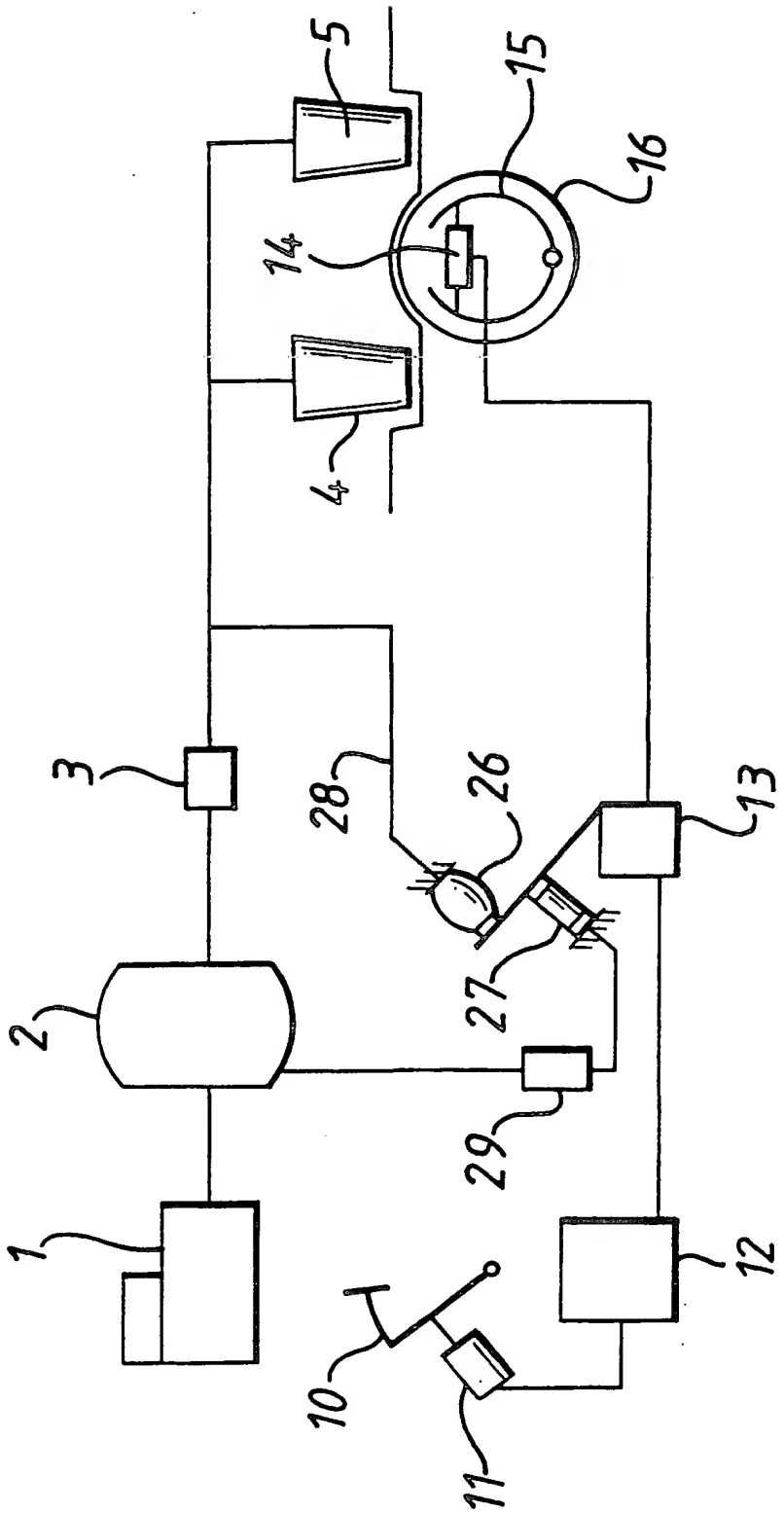
29. A load sensing system according to any of claims 20 to 28, wherein the restoring force increases as the valve element approaches its open position.

30. A load sensing system according to claim 19, wherein the pressure in the air suspension unit is sensed by an electrical or electromechanical sensor to provide an electrical output signal corresponding to the suspension unit pressure, and the variable throttling valve is electrically controllable to vary the flow of brake fluid to a brake actuator, and the control means comprises a control circuit varies the throttling effect of the throttling valve in dependence on the output signal from the pressure sensor.

31. A load sensing system according to claim 19, comprising a detector responsive to a spacing between the vehicle body and the axle, a sensor to give an electrical output corresponding to suspension unit pressure, and an electrically controllable throttling valve to vary the flow of brake fluid to a brake actuator, the control means providing control signals to the throttling valve

in dependence on the sensed suspension unit pressure and the spacing between the vehicle body and axle.

FIG. 1



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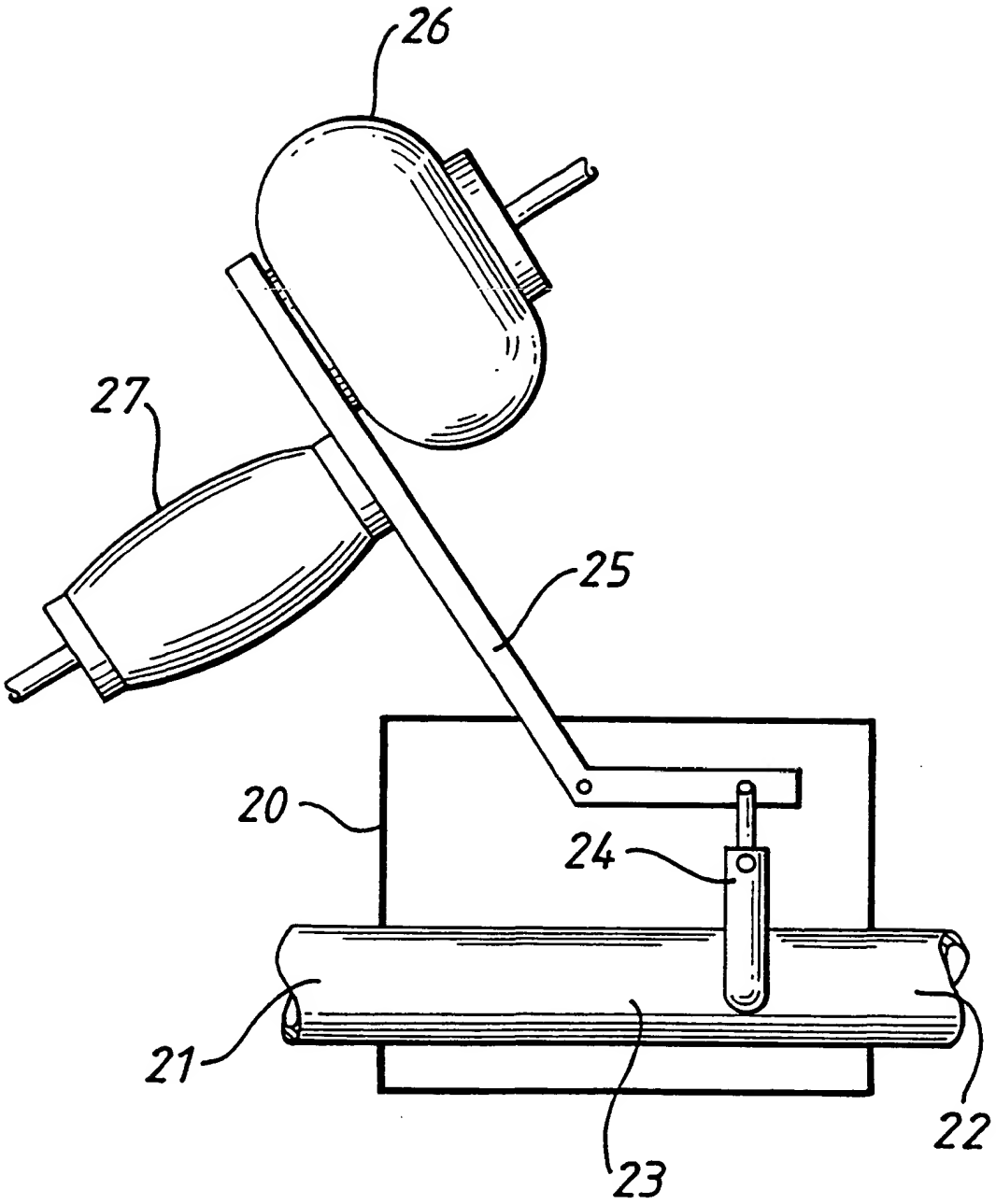


FIG. 2A

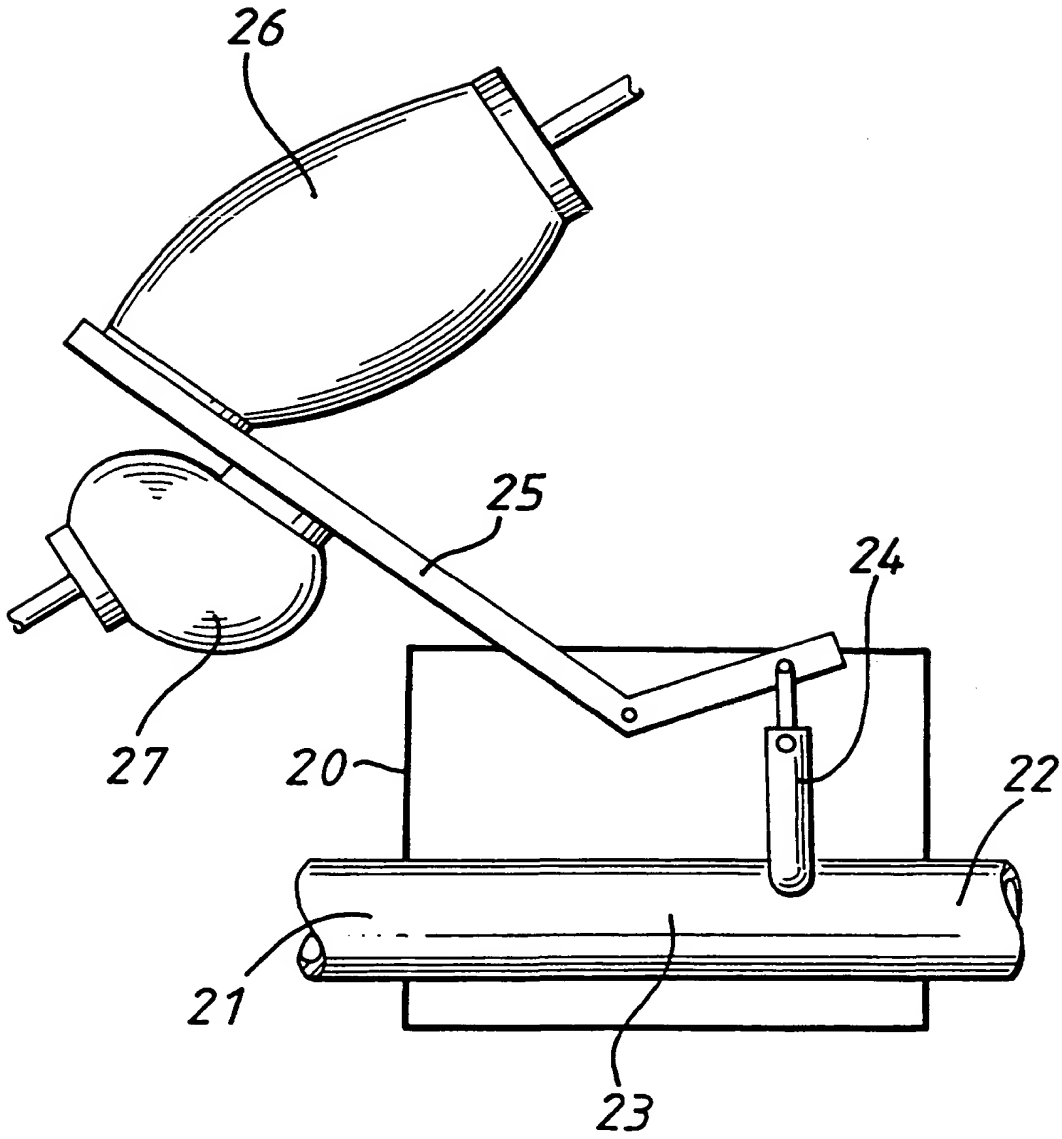


FIG. 2B

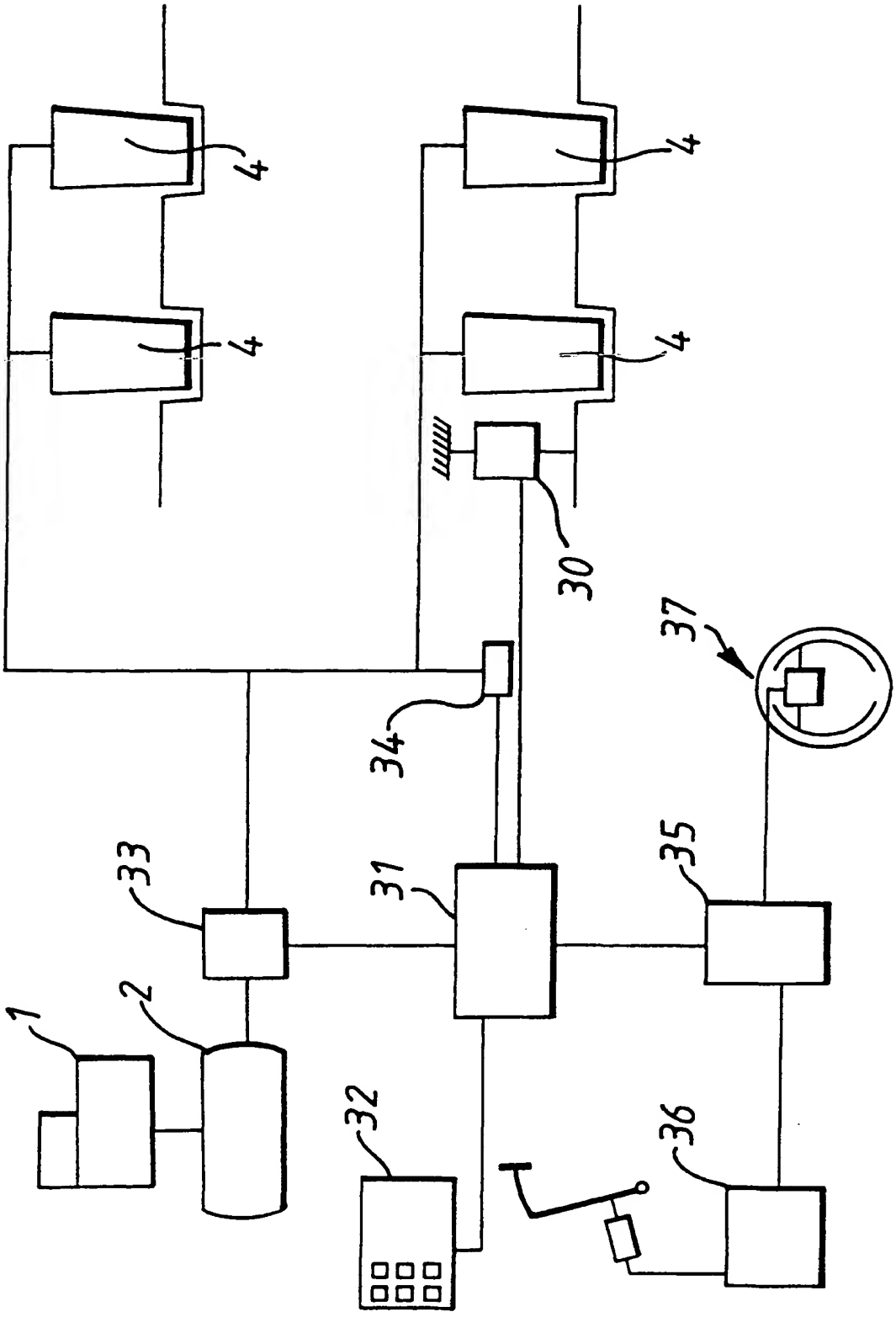


FIG. 3

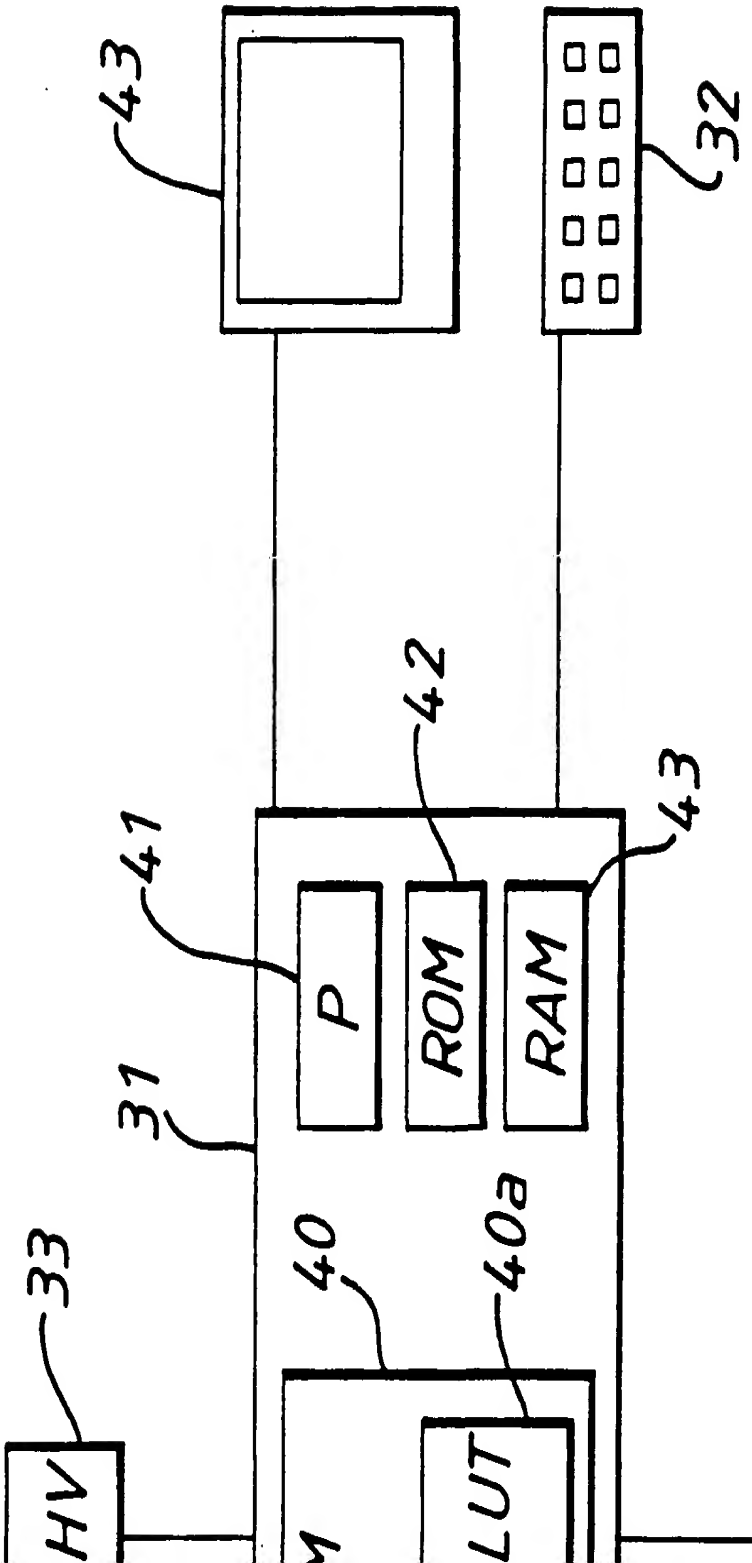
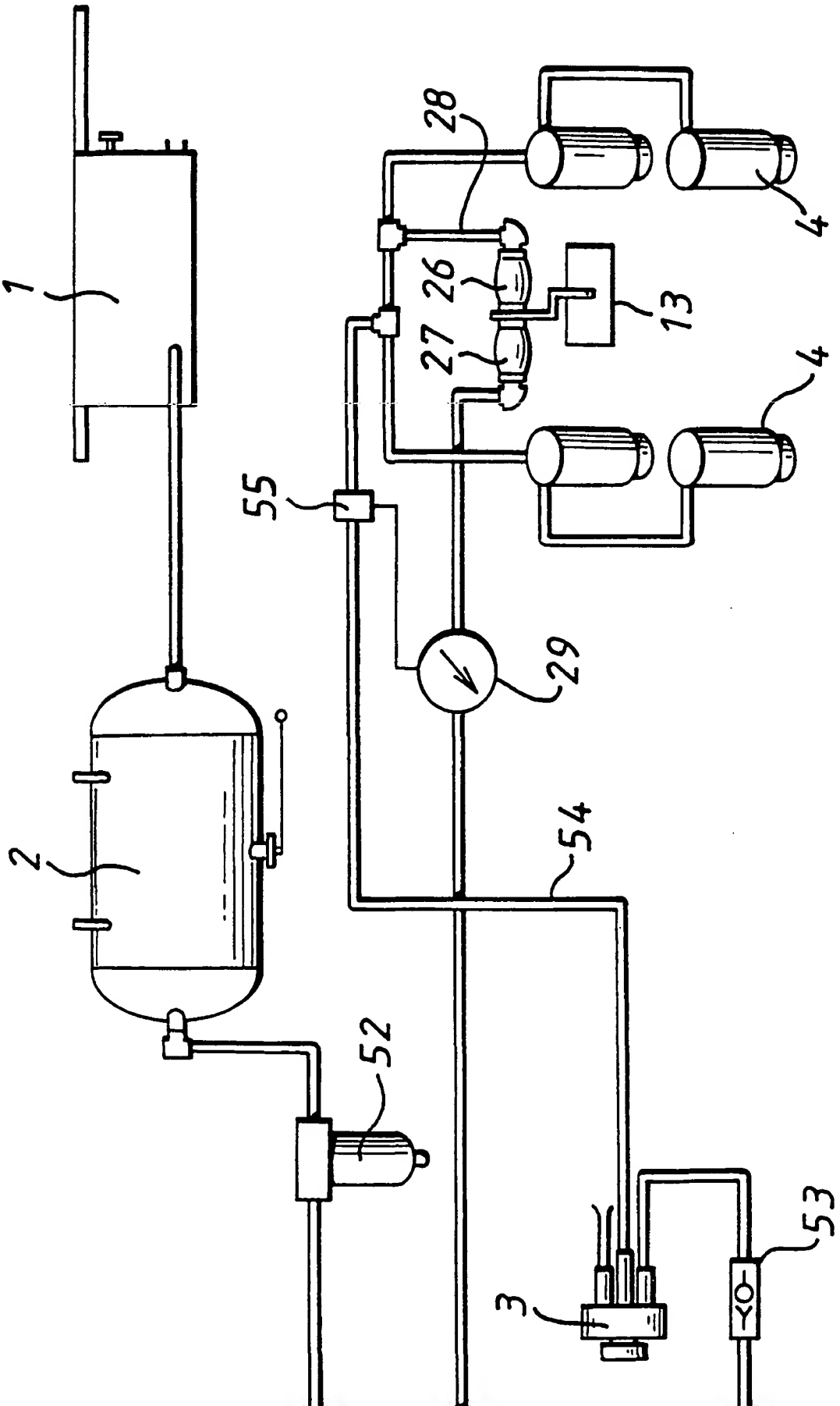


FIG. 4

FIG. 5



INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/GB 00/00089

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60T8/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 836 100 A (KNORR-BREMSE GMBH) 1 June 1960 (1960-06-01) the whole document ---	1-4, 11-14, 16, 18-20, 27-29
X	PATENT ABSTRACTS OF JAPAN vol. 009, no. 226 (M-412), 12 September 1985 (1985-09-12) -& JP 60 082471 A (HINO JIDOSHA KOGYO KK), 10 May 1985 (1985-05-10) abstract; figures	1-4, 11-14, 16, 18-20, 27-29
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2000	17/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx 31 651 epo nl,	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00089

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 162 491 A (VAN WINSEN FRIEDRICH H) 22 December 1964 (1964-12-22) column 1, line 11 -column 2, line 14; figures 2,3 column 3, line 45 -column 4, line 13; figure	1-4,6, 8-10,13, 14,16, 18-22, 24,29
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 164 (M-313), 28 July 1984 (1984-07-28) -& JP 59 059552 A (ISUZU JIDOSHA KK), 5 April 1984 (1984-04-05) abstract; figures 1-3	1-3, 11-14, 16-20, 27-31
X	WO 93 19959 A (DRIVERITE LIMITED ;NASH HAROLD (IE); RONAN BRENDAN (IE); CARSON PA) 14 October 1993 (1993-10-14) page 2, line 21 -page 3, line 25; figures 2-7 page 12, line 6 -page 13, line 21; figures 13-15 page 14, line 28 - line 29 page 8, line 26 -page 10, line 18	1,2, 13-15, 17-19, 30,31
Y		5
A		3,4,11, 12,20, 27,28

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

information on patent family members

Int ational Application No
PCT/GB 00/00089

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 836100 A		CH 363248 A	
		FR 1208795 A	25-02-1960
JP 60082471 A	10-05-1985	NONE	
US 3162491 A	22-12-1964	FR 1279050 A	18-04-1962
JP 59059552 A	05-04-1984	JP 1739550 C	26-02-1993
		JP 4028577 B	14-05-1992
WO 9319959 A	14-10-1993	AT 166621 T	15-06-1998
		AU 3766493 A	08-11-1993
		DE 9390073 U	03-02-1994
		DE 69318832 D	02-07-1998
		DE 69318832 T	03-12-1998
		EP 0633849 A	18-01-1995
		IE 73659 B	18-06-1997

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/00089

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60T8/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 836 100 A (KNORR-BREMSE GMBH) 1 June 1960 (1960-06-01) the whole document	1-4, 11-14, 16, 18-20, 27-29
X	PATENT ABSTRACTS OF JAPAN vol. 009, no. 226 (M-412), 12 September 1985 (1985-09-12) -& JP 60 082471 A (HINO JIDOSHA KOGYO KK), 10 May 1985 (1985-05-10) abstract; figures	1-4, 11-14, 16, 18-20, 27-29
Y		5

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2000	17/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Meijs, P

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/00089

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 162 491 A (VAN WINSEN FRIEDRICH H) 22 December 1964 (1964-12-22) column 1, line 11 -column 2, line 14; figures 2,3 column 3, line 45 -column 4, line 13; figure	1-4,6, 8-10,13, 14,16, 18-22, 24,29
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 164 (M-313), 28 July 1984 (1984-07-28) -& JP 59 059552 A (ISUZU JIDOSHA KK), 5 April 1984 (1984-04-05) abstract; figures 1-3	1-3, 11-14, 16-20, 27-31
X	WO 93 19959 A (DRIVERITE LIMITED ;NASH HAROLD (IE); RONAN BRENDAN (IE); CARSON PA) 14 October 1993 (1993-10-14) page 2, line 21 -page 3, line 25; figures 2-7 page 12, line 6 -page 13, line 21; figures 13-15 page 14, line 28 - line 29 page 8, line 26 -page 10, line 18	1,2, 13-15, 17-19, 30,31
Y		5
A		3,4,11, 12,20, 27,28

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
5293299		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 00089	14/01/2000	15/01/1999

Applicant

GLIDE-RITE PRODUCTS LIMITED et al.

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readbie form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] None of the figures.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 00/00089

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

The abstract is modified as follows:

line 8: " sensing valve (13)" should read: " sensing valve (13,35);
line 12: " control means (26,28) " should read: " control means (25-28,31)";
line 12: Delete the words "including a sensor".

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/00089

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 836100 A		CH 363248 A	
		FR 1208795 A	25-02-1960
JP 60082471 A	10-05-1985	NONE	
US 3162491 A	22-12-1964	FR 1279050 A	18-04-1962
JP 59059552 A	05-04-1984	JP 1739550 C	26-02-1993
		JP 4028577 B	14-05-1992
WO 9319959 A	14-10-1993	AT 166621 T	15-06-1998
		AU 3766493 A	08-11-1993
		DE 9390073 U	03-02-1994
		DE 69318832 D	02-07-1998
		DE 69318832 T	03-12-1998
		EP 0633849 A	18-01-1995
		IE 73659 B	18-06-1997

INTERNATIONAL SEARCH REPORT

Inte Jional Application No
PCT/GB 00/00089

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60T8/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 836 100 A (KNORR-BREMSE GMBH) 1 June 1960 (1960-06-01) the whole document	1-4, 11-14, 16, 18-20, 27-29
X Y	PATENT ABSTRACTS OF JAPAN vol. 009, no. 226 (M-412), 12 September 1985 (1985-09-12) -& JP 60 082471 A (HINO JIDOSHA KOGYO KK), 10 May 1985 (1985-05-10) abstract; figures	1-4, 11-14, 16, 18-20, 27-29 5

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2000	17/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Meijs, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int. .tional Application No
PCT/GB 00/00089

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate. of the relevant passages	Relevant to claim No.
X	US 3 162 491 A (VAN WINSEN FRIEDRICH H) 22 December 1964 (1964-12-22) column 1, line 11 -column 2, line 14; figures 2,3 column 3, line 45 -column 4, line 13; figure	1-4,6, 8-10,13, 14,16, 18-22, 24,29
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 164 (M-313), 28 July 1984 (1984-07-28) -& JP 59 059552 A (ISUZU JIDOSHA KK), 5 April 1984 (1984-04-05) abstract; figures 1-3	1-3, 11-14, 16-20, 27-31
X	WO 93 19959 A (DRIVERITE LIMITED ;NASH HAROLD (IE); RONAN BRENDAN (IE); CARSON PA) 14 October 1993 (1993-10-14) page 2, line 21 -page 3, line 25; figures 2-7 page 12, line 6 -page 13, line 21; figures 13-15 page 14, line 28 - line 29 page 8, line 26 -page 10, line 18	1,2, 13-15, 17-19, 30,31
Y		5
A		3,4,11, 12,20, 27,28

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

information on patent family members

Int ational Application No
PCT/GB 00/00089

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 836100 A		CH 363248 A	
		FR 1208795 A	25-02-1960
JP 60082471 A	10-05-1985	NONE	
US 3162491 A	22-12-1964	FR 1279050 A	18-04-1962
JP 59059552 A	05-04-1984	JP 1739550 C	26-02-1993
		JP 4028577 B	14-05-1992
WO 9319959 A	14-10-1993	AT 166621 T	15-06-1998
		AU 3766493 A	08-11-1993
		DE 9390073 U	03-02-1994
		DE 69318832 D	02-07-1998
		DE 69318832 T	03-12-1998
		EP 0633849 A	18-01-1995
		IE 73659 B	18-06-1997

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 September 2000 (04.09.00)	
International application No. PCT/GB00/00089	**Applicant's or agent's file reference** 5293299
International filing date (day/month/year) 14 January 2000 (14.01.00)	**Priority date** (day/month/year) 15 January 1999 (15.01.99)
Applicant GLAZIER, Mark	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

10 August 2000 (10.08.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Zakaria EL KHODARY

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
5293299		

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00089	14/01/2000	15/01/1999

International Patent Classification (IPC) or national classification and IPC
B60T8/18

Applicant
GLIDE-RITE PRODUCTS LIMITED et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 10 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10/08/2000	15.01.2001

Name and mailing address of the international preliminary examining authority:

European Patent Office - P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel. +31 70 340 - 2040 Tx: 31 651 epo nl
Fax: +31 70 340 - 3016

Authorized officer

Meijs, P

Telephone No. +31 70 340 2690

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00089

I. Basis f th r p rt

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1-20 as originally filed

Claims, No.:

1-31 as originally filed

Drawings, sheets:

1/6-6/6 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	5,7,23,25,26
	No:	Claims	1-4,6,8-22,24,27-31
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-31
Industrial applicability (IA)	Yes:	Claims	1-31
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
s e separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The present description basically shows three embodiments of the invention which support the claims, the inventive concept being the adjustment of the load sensing valve in dependence of the pressure inside the air springs. The three embodiments described solving the underlying problem of the invention are one purely electric solution (compare embodiment of present figure 3), and two pneumatic solutions, in one solution the air suspension pressure being countered by a spring force (see present description) and in the other one by a controlled pressure (compare embodiments of figures 1 and 5).

1.1. The above electric solution is anticipated by the subject-matter of JP59059552A, wherein items 14 are pressure transducers, items 28 electrically controlled load sensing valves and items 15 seem to be detectors of the spacing between vehicle body and axle.

1.2. The above first pneumatic solution is anticipated by GB836100A and JP60082471A.

1.3. The above second pneumatic solution is anticipated by US3162491A, wherein the controlled pressure is derived from the regulated air spring pressure and not, like in the present application, the reservoir pressure.

2. Because of the unclear (see **Re Item VIII**) and broad wording of the present claims, the subject-matter of the above mentioned documents even seems to anticipate some claims which relate to other embodiments.

2.1. The claims as they stand and as far as they can be understood are hereafter commented upon:

2.2. GB836100A [D1] describes (cf. independent claim 1) a vehicle having a body (1) suspended on one or more axles (7) by means of gas-filled suspension units (3,5), the vehicle being provided with means (33,35,37,39,41,43) to vary the pressure within the suspension units (3,5) to control the spacing between the body and the axle or axles and a braking system supplying a brake fluid to braking actuators (21) operable to brake the vehicle's wheels (9,11), and further comprising a load sensing valve (15) operable to apply a variable throttling effect to impede the flow of brake fluid to the braking actuators (21) **and still** further comprising means (17,48-51,53) to vary the throttling effect of the load sensing valve (15) in dependance on the pressure within the gas-filled suspension units (3,5).

2.2.1. Thus, D1 describes all the features of present independent claim 1. Therefore, the subject-matter of present independent claim 1 is not novel in respect of the prior-art as defined in the regulations (Rule 64(1)-(3) PCT). Hence, the application does not satisfy the criterion set forth in Article 33(2) PCT.

2.2.2. A similar objection under Article 33(2) PCT could be raised against independent claim 1 on the basis of each of the documents JP60082471A [D2] (like in the present application the "vehicle" being implicitly present), US3162491A [D3] ("means to vary pressure within the suspension units" being implicitly present), JP59059552A [D4] ("vehicle" implicitly present) and WO93/19959A [D5].

2.2.3. If the finding above that some documents implicitly show the mentioned features be contested, these features are at least not considered inventive according to Article 33(3) PCT, since no inventive step can be seen in applying the shown systems in vehicles [e.g. D1, D3 or D5] or adding a well known height control mechanism [e.g. D1 or D2]

2.3. D3 shows (cf. independent claim 18) a load sensing system [suitable] for a braking system of a vehicle [see Guidelines PCT/GL/IPE/1, III-4.8] having a vehicle body (see

top left of figure 2) supported on an axle (see top left of figure 2 and column 3, lines 10 to 16) by a pressurised air suspension unit (41) whose pressure is varied as the vehicle load varies, the load sensing system comprising a variable throttling valve (35,37,38) operable to control the flow of brake fluid to a brake actuator (46), and control means (29,34) to vary the throttling effect of the throttling valve in dependence on the pressure in the air suspension unit (41).

2.3.1. Thus, D3 describes all the features of present independent claim 18. Therefore, the subject-matter of present independent claim 18 is not novel in respect of the prior-art as defined in the regulations (Rule 64(1)-(3) PCT).

2.3.2. An objection under Article 33(2) PCT against independent claim 18 could also be raised on the basis of each of the documents D1, D2, D4 and D5.

2.4. The subject-matter of dependent claims 2 to 4, 6, 8 to 17, 19 to 22, 24 and 27 to 31 seems to be know from the above mentioned documents D1 to D5. The subject-matter of these claims is, therefore, not novel (Article 33(2) PCT).

2.5. The subject-matter of each of the claims 5, 7, 23, 25 and 26 is not known from any single document cited in the international Search Report. Hence, the subject-matter of each of these claims satisfies the criterion set forth in Article 33(2) PCT.

2.5.1. However, claims 5, 7, 23, 25 and 26 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, give rise to subject-matter that involves an inventive step (Article 33(3) PCT) as all the features introduced with these claims seem to be known while used with a known corresponding effect or seem to be merely minor modifications (workshop variants) which come within the scope of customary practice followed by persons skilled in the art; compare for example the features introduced with claims 5, 7 and 23 with D5 and D1, page 2, lines 62 to 71.

2.5.2. Moreover, the features of these dependent claims 5, 7, 23 , 25 and 26 at least on their own do not seem to solve any particular technical problem with respect to the cited

prior art [D1-D5] and can, therefore, not give rise to any inventive subject-matter.

Re Item VII

Certain defects in the international application

1. To fulfil the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D3, or D4, should have been mentioned in the description of the present application.
It should also have been made unambiguously clear in the description, which document is seen as the closest prior art describing all the features of the preamble of an independent claim fulfilling the requirements of Article 33 PCT.

1.1. D4 should have been chosen as the closest prior art for an independent claim fulfilling the requirements of Article 33 PCT relating to the electrical solution (embodiment of figure 3 of the present application). D3 should have been chosen as the closest prior art for an independent claim fulfilling the requirements of Article 33 PCT relating to the "pressure regulator (29)" of the pneumatic embodiment. D1 should have been chosen as closest prior art for an independent claim fulfilling the requirements of Article 33 PCT relating to the "control means (25,26,27)" as shown in figures 2 and 3 of the present application.

2. Independent claim 18 has not been drafted in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would have been appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

2.1. Or, it should have been made clear from the description which features of the subject-matter of present independent claim 18 are already known in combination from

the closest prior art document (see the PCT Guidelines, III-2.3a), e.g. by listing in the introductory part of the description those features that otherwise would have been in the preamble of the independent claim.

3. The features of the claims have not been provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

4. The units of pressure on page 4, line 4 have not been additionally expressed in terms of the units stipulated by Rule 10.1(a) PCT like those on page 18 of the present application and following.

5. The wording of the statement of invention on page 6, lines 8 to 20 should have been made identical to the wording of independent claim 1. The wording of the statement of invention on page 6, line 21 to page 7, line 4 should have been made identical to the wording of independent claim 18. This objection also applies to page 7, line 5 to page 8, line 13 where discussing dependent claims.

5.1. Moreover, the expressions used in these passages are **not** matching those of the independent claims. This objection also applies to the part where describing preferred embodiments (page 7, line 5 to page 8, line 13). See also Rule 10.2 PCT.

These objections should have been remedied.

5.2. The wording of page 6, line 8 to page 7, line 4 should have been made identical to an independent claim fulfilling the requirements of Article 33 PCT.

6. According to the requirements of Rule 11.13(l) reference signs not appearing in the description shall not appear in the drawings, and vice versa. This requirement has not been met in view of the reference sign 16.

7. Embodiments not supporting an independent claim fulfilling the requirements of Article 33 PCT should have been erased from the present application (description, claims and drawings), see Rule 9.1 (iv) and Guidelines PCT/GL/IPE/1, II-6.3.

Re Item VIII
Certain observations on the international application

1. The terminology of the claims has not been made identical to that of the description, contrary to the provisions of Article 6 PCT and Rule 10.2 PCT. This renders (the understanding of) the present claims unclear.

1.1. Moreover, some expressions (like "sensor" etc.) seem to be used outside their normal context. See Guidelines PCT/GL/IPE/1, III-4.2.

These shortcomings should have been resolved.

2. The present set of 31 claims comprising two independent claims and twenty-nine claims being dependent on those two independent claims does not meet the requirement of conciseness according to Article 6 PCT and Guidelines PCT/GL/IPE/1, III-5.1. Clearly, one independent claim 1 with a limited number of dependent claims should have been sufficient to cover the present invention / inventive subject-matter.

2.1. The difference between the independent claims 1 and 18 seems merely to be the presence of a vehicle. This aspect could, for instance, also have been claimed in a

dependent claim on present independent claim 18.

3. The following clarity objections exist against the claims:

3.1. Claim 10: "reference pressures" (page 23, line 16) should for reasons of consistency apparently have read "reference fluid pressures".

3.2. Claim 10: "control means" should apparently have read "regulator means".

3.3. Claim 13: page 24, lines 12 to 14 do not seem to be supported by the description.

3.4. There being no antecedent for the expression "the load sensing valve" in present claim 18 (page 25, last line to page 26, first line), this expression should apparently have read "the variable throttling valve".

3.5. Claim 20 (and following): "open" and "closed" positions of the "load sensing valve" / "variable throttling valve" are not shown in the present description: only positions with a minimum or maximum throttling effect.

3.6. It seems that in claims 20 to 31 the "load sensing valve (13)" shown in figures 2A and 2B is linked to the embodiment of figure 3, the electric / electro-magnetic actuation of such a valve not being shown in your description.

3.7. Claim 31: Only an electrical "detector" (page 28, line 20) is depicted in the present description. The detector being electrical should have been made cl[illegible]